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Amended Brief

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Applicant(s) Kenneth Boyd

Serial Number: 10/707,366 Group Art Unit: 2128

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Title: METHOD AND APPARATUS FOR CONTROLLING A VEHICLE COMPUTER MODEL WITH UNDERSTEER

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___________8/6/09________________ Lisa E. Brown

RESPONSE TO NOTICICIFICATION OF NON-COMPLIANT APPEAL BRIEF

This is a response to the Notification dated July 17, 2009. A Replacement Brief is presented herein.

APPELLANTS' BRIEF ON APPEAL

Sir:

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I. Statement of Real Party in Interest

The inventor or inventors listed above have assigned their rights in the invention and the present application to Ford Global Technologies, LLC.

II. Related Appeals and Interferences

An Appeal Brief was filed July 23, 2007 for 10/707,368 (Appeal No. 2009-4119) and is awaiting Appeal Board Review.

An Appeal Brief was filed June 22, 2009 for 10/707,366.

III. Status of Claims

Claims 1-20 are under appeal. Claims 1-20 stand under final rejection under 35 U.S.C. §103(a) as being unpatentable over Sharp et al., "Optimal Preview Car Steering Control," published in Vehicle Systems Dynamics, Volume 35, no. ICTAM, in 2001, in view of Peng et al., "Optimal Preview Control for Vehicle Lateral Guidance", California Partners for Advanced Transit and Highways, 1991.

IV. <u>Status of Amendments</u>

No amendment was filed after final rejection.

V. Summary of Claimed Subject Matter

1. A simulation system {Fig. 2, element 30 ¶ 0023} for simulating operation of an automotive vehicle, said simulation system comprising:

an input device {Fig. 2, element 34, ¶0023} for providing vehicle information and path information;

a controller {Fig. 2, element 38, ¶0026} coupled to said input device {Fig. 2, element 34, ¶0023} and operable to simulate said automotive vehicle using a vehicle computer model {Fig. 5, ¶0033}, wherein said controller is programmed to

determine a rear side slip angle {Fig. 5, element 100, ¶0033} of said vehicle computer model;

determine an initial steering wheel angle that is input to said vehicle computer model {Fig. 4, element 78, ¶0030};

when said rear side slip angle is determined to be greater than a predetermined threshold {Fig. 5, element 100, ¶0034}, determine a look ahead scale factor {Figs. 6 and 7, ¶0035} and increase the distance of a look ahead point substantially on or near an intended vehicle path as a function of said look ahead scale factor {Fig. 5, element 114, ¶0034};

determine a new steering wheel angle {Fig. 5, element 106, ¶0034}, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path {Fig. 5, element 106, ¶0034};

operate said vehicle computer model with said initial steering wheel angle or said new steering wheel angle {Fig. 6 & 7, element 126, ¶0036}; and

generate an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle {Fig. 7, element 126, §0036}.

10. A method of operating a vehicle computer model {Fig. 5, ¶0033} having vehicle information and path information therein, said method being operable on a digital computer system {¶0021} and comprising the steps of:

(a) determining a rear side slip angle of said vehicle computer model {Fig. 5, element 100, ¶0033};

(b) determining an initial steering wheel angle that is input to said vehicle computer model {Fig. 4, element 78, ¶0030};

(c) when said rear side slip angle is determined to be greater than a predetermined threshold {Fig. 5, element 100, ¶0034}, determining a look ahead scale factor {Figs. 6 & 7, ¶0035} and increasing the distance of a look ahead point substantially on or near an intended vehicle path as a function of said look ahead scale factor {Fig. 5, element 114, ¶0034};

(d) determining a new steering wheel angle {Fig. 5, element 110, ¶0034}, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path {Fig. 5, ¶0034};

(e) operating said vehicle computer model with said initial steering wheel angle or said new steering wheel angle {Figs. 6 & 7, element 106, ¶0034}; and

(f) generating an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle {Fig. 7, element 126, ¶0036}.

19. A method of operating a vehicle computer model {Fig. 5, ¶0033} having vehicle information and path information therein, said method comprising the steps of:

determining a rear side slip angle of said vehicle computer model {Fig. 5, element 100, ¶0033};

determining an initial steering wheel angle that is input to said vehicle computer model {Fig. 4, element 78, ¶0030};

determining a look ahead point {Fig. 5, element 114, ¶0034} that is substantially on or near an intended vehicle path for said vehicle computer model {Fig. 5, ¶0034};

when said rear side slip angle is determined to be greater than a predetermined threshold {Fig. 5, element 100, ¶0034}, determining a look ahead scale factor {Figs. 6 and 7, ¶0035} and increasing the distance of said look ahead point as a function of said look ahead scale factor {Fig. 5, element 114, ¶0034};

when said rear side slip angle is alternatively determined to be less than said predetermined threshold {Fig. 5, element 100, ¶0033}, maintaining the distance of said look ahead point {Fig. 5, element 102, ¶0033};

when said vehicle computer model is determined to be headed off a predetermined target {Fig. 5, element 106, ¶0034}, determining a new steering wheel angle {Fig. 5, element 110, ¶0034}, which is input to said vehicle computer model, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path;

operating said vehicle computer model with said initial steering wheel angle or said new steering wheel angle; and

generating an output in response to said vehicle computer model and said initial steering wheel angel or said new steering wheel angle {Fig. 5, ¶0034}

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VI. Grounds of Rejection to be Reviewed on Appeal

Are claims 1-20 patentable under 35 U.S.C. §103(a) over Sharp et al., "Optimal Preview car Steering Control", published in Vehicle System Dynamics, Volume 35, no. ICTAM, in 2001, in view of Peng et al., "Optimal Preview Control for Vehicle Lateral Guidance", California Partners for Advanced Transit and Highways, 1991?

VII. Argument

Rejection of Claims 1-20 under 35 U.S.C. §103

It is respectfully asserted that there is no motivation or suggestion, either in the references themselves or in the knowledge generally available to one of skill in the art, to achieve the present invention and that the references, either alone or in combination, do not present a reasonable expectation of success to accomplish the present invention. It is also respectfully asserted that, even when combined, the cited references do not teach all of the limitations claimed in the present invention. And lastly, it is respectfully asserted that the improvement provided by the simulation system and method of the present invention is more than a predictable use of prior-art elements, such as those disclosed in the cited references. The prior art simulation systems are configured such that they are not capable of, or simply avoid, the collection of data during aggressive driving maneuvers, or attempt to correct a potential problem without the ability to collect meaningful data. The present invention addresses an important consideration in aggressive driving maneuvers with the inventive subject matter that is not a possible outcome using the teachings of the Sharp and Peng references, either alone or in their combination.

The present invention is directed to a simulation system that simulates the interaction between a driver and a vehicle dynamics. The intended path claimed in the present invention is taught to be a driver's intended path and is not necessarily the driver's attempt to follow a known road curvature. The driver intended path is described in the specification as filed at paragraph [0004]-[0007]. The intended vehicle path as claimed in present invention is a function of the distance of a look-ahead point and is used to determine a look-ahead scale factor that is a function of a rear side slip angle. According to the independent claims of the present invention, the look-ahead distance is increased or decreased as a function of the rear side slip angle of the vehicle computer model. The rear side slip angle is determined as described in the specification at paragraph [0033] and is a function of the lateral vehicle velocity and the longitudinal vehicle velocity. Beginning at paragraph [0034] of the specification and as claimed in independent claims 1, 10, and 19, if the rear side slip angle is greater than a threshold, a look ahead scale factor determination is made. The scale factor will be multiplied by the look ahead distance to increase, or decrease, the look ahead distance of the vehicle model.

The simulation system of the present invention generates a current steering wheel angle that is based on the size of the error between the look ahead point and the intended vehicle path, keeping in mind that the intended vehicle path may have been increased, or decreased, by the look ahead scale factor. This allows the

vehicle model of the present invention to be controlled in various conditions, such as understeering, oversteering, and aggressive driving.

It is respectfully asserted that one skilled in the art would have no reason to combine the references cited by the Examiner and that even if combined, the combination of references does not teach or disclose a simulation system that, when a rear side slip angle is determined to be greater than a predetermined threshold, determines a look ahead scale factor to affect the distance of a look ahead point substantially on or near an intended vehicle path as a function of the look ahead scale factor as claimed in the present invention.

The references are directed to a typical lane following control simulation that the present invention discusses at paragraph [0005]-[0007]. The Sharp reference is directed to an optimized model for three different steering control situations. In an Office Action dated January 23, 2009 the Examiner indicated that the Sharp reference does not disclose path information or the look ahead scale factor being a function of the intended vehicle path which is proportional to slip angle. The Examiner indicated that the Peng reference teaches an input having path information containing a radius of curvature (page 6, last paragraph) and a look ahead scale factor as a function of path radius of curvature (page 9, equation 17). The Examiner asserted that it would have been obvious to one of ordinary skill in the art to combine the references. Appellants respectfully traverse.

Appellants assert that the Peng reference does not teach or disclose an intended vehicle path as claimed in the present invention. The Peng reference teaches actual path information, which is known road curvature information, and is either obtained by measuring the road geometry or is obtained from transportations agencies and retrieved from an on-board database. It is respectfully asserted that the known road curvature path taught in Peng is significantly different than the intended vehicle path taught and claimed in the present invention. The Sharp and Peng references teach following a known road curvature, and correcting steering wheel angle when the vehicle departs from the known road curvature path.

The present invention does not correct steering wheel angle upon departure from the known road curvature. The present invention is directed to a driver intended path and continues operating with a current steering wheel angle until certain conditions are met with respect to a look ahead distance that is dependent upon a rear side slip angle. This allows the current steering wheel angle to be maintained, even when experiencing aggressive driving maneuvers, so that meaningful data can be collected by the simulation system. See paragraph [0032] of the specification at page 10, where it states, "As can be seen, the steering wheel angle is not allowed to be changed to provide an undesirable result as in previous models. Thus, the current SWA value is held (while being monitored in step 90) until the value when it is determined that the vehicle is plowing is reached."

Again, at paragraph [0034] at page 11 of the specification, "By providing the increased look ahead distance, the vehicle computer model generates useful results." In other words, the present invention does not use the typical simulated look ahead to determine whether the vehicle is on a known path, such as the simulation system disclosed in the combination of the Sharp and Peng references. These simulation systems are not typically designed to test the limits of control of the vehicle.

The "intended" vehicle path in the present invention is the driver's intended path and is determined as a function of the rear side slip angle. Under typical, or normal, driving conditions, a driver would attempt to follow the road and the driver models taught and described in the Sharp and Peng references both utilize preview and optimal control concepts and techniques that emulate a driver's lane following behavior using the road curvature information. The present invention is significantly different in that the model may intentionally deviate from the road path. The intended path taught and claimed in the present invention is a function of the rear side slip angle, so that the intended path may deviate from the road. The simulation of the present invention allows vehicle designers to assess the vehicle handling under aggressive driving conditions. This concept is not addressed in either the Sharp or Peng references. The combination of the cited references teaches following known road curvatures and does not allow for

deviation from a known path. There is no motivation to combine the references as suggested by the Examiner, and even if combined, their combination would not have a reasonable expectation of success, specifically because when combined, they fail to teach all of the claim limitations of the present invention.

The present invention is directed to gathering useful information from the vehicle model during periods of aggressive driving conditions. To accomplish this, the present invention teaches and claims an "intended" vehicle path as opposed to a vehicle path that is based on road curvature information. Therefore, it is respectfully asserted that there is no motivation to combine Sharp and Peng in an attempt to achieve this result. Both the Sharp and Peng references are directed to reduce error in calculating preview data, and Peng is directed to considering changes in road curvature in those calculations. However, neither reference, either alone or in combination, determines the look ahead scale factor as a function of rear side slip angle, nor does the combination of references address the "intended" vehicle path claimed in the present invention.

Further, it is respectfully asserted that even if the references were combined as suggested by the Examiner, their combination would not result in the present invention. The present invention teaches and claims that when a rear side slip angle is determined to be greater than a predetermined threshold, a look ahead scale factor is determined and an initial look ahead point is determined. The Sharp

reference discloses a lateral deviation from a fixed straight line given as a discrete function corresponding to vehicle speed. The road preview updated process in Sharp is disclosed to be a shift register type of operation. The preview point, or look ahead distance, is determined from the preview time, which is speed dependent according to the teachings of Sharp. The Examiner indicated in the Office Action dated May 13, 2008 that the shift register preview point in Sharp effectively teaches "when the rear side slip angle is determined to be greater than a predetermined threshold, determine a look ahead scale factor and an initial look ahead point" as taught and claimed in the present invention. Appellants respectfully disagree. It is respectfully asserted that the shift register type of operation relative to the vehicle's speed does not constitute disclosure or teaching of a look ahead scale factor and an initial look ahead point when a rear side slip angle exceeds a threshold value as claimed in the present invention.

In the Office Action dated May 13, 2008, the Examiner suggested that the Peng reference discloses a method of controlling a vehicle using an optimal preview control algorithm, and that the Peng reference teaches the path information comprising a road radius of curvature, and the look ahead scale factor is a function of the intended path which is proportional to the slip angle. Appellants respectfully traverse.

The Peng reference uses “known” road curvature information to determine the path. The “known” information is determined by measurements provided from a variety of sources. However, the information used to determine “known” road curvature information in Peng is not a function of rear side slip angle as claimed in the present invention. Further, the “known” road curvature information disclosed in the Peng reference is an actual path and is not directed to an “intended path” which may or may not follow the road curvature as taught and claimed in the present invention. It is respectfully asserted that the “known” road curvature information in Peng is derived from the road. This assertion is supported by the fact that the Peng reference teaches a finite preview time. The finite preview time implies that a “limited” known path is relied on, as opposed to the “intended” path taught and claimed in the present invention. Furthermore, any measurement data in Peng is taken from the road geometry itself.

The “intended” vehicle path in the present invention is a function of the look ahead scale factor which is affected as a function of rear side slip angle. According to the teachings of the present invention, the driver may intend to deviate from the known road curvature and the simulation system will allow the vehicle model to be controlled in various conditions and continue to collect meaningful data so that vehicle designers can quickly and readily determine how the vehicle handling reacts to these various handling events. This is not possible

with the teachings of Sharp and Peng, which alter the steering wheel angle once the vehicle is sensed to be departing from a known road curvature.

Further support for the argument that Peng relies only on known path information may be found at page 3, fourth full paragraph of the Peng reference, which teaches special on-board look-ahead sensors that are required to implement the control algorithms. The sensed preview information that is required pertains to road curvature and superelevation, which is measured from road geometry or obtained from transportation agencies. In the Peng reference, the path is the actual path of the road curvature and is based on actual road information. It is respectfully asserted that this is not an "intended" path as claimed in the present invention, which is a function of a look ahead scale factor and is dependent upon the vehicle rear side slip angle.

Therefore, because neither the Sharp reference nor the Peng reference, alone or in their combination, teach or disclose determining a look ahead scale factor, when the rear side slip angle is determined to be greater than a predetermined threshold, and increase the distance of a look ahead point substantially on or near an intended vehicle path as a function of said look ahead scale factor, their combination does not result in the Appellants' invention.

In summary, it is respectfully asserted that one skilled in the art has no reason to combine the references as cited by the Examiner, that even if combined, there is no reasonable expectation of success in accomplishing the present invention. Lastly, it has been presented that the combination of references fails to teach all of the claim limitation of the present invention.

Conclusion

It is respectfully asserted that the rejection of claims 1-20 under 35 U.S.C. §103(a) be withdrawn and that a formal Notice of Allowance issue for all claims.

Please charge Deposit Account 06-1510 the statutory fee for filing this document as required by 37 CFR 1.17(c).

Respectfully submitted,

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VIII. Claims Appendix

1. (Previously presented) A simulation system for simulating operation of an automotive vehicle, said simulation system comprising:

an input device for providing vehicle information and path information;

a controller coupled to said input device and operable to simulate said automotive vehicle using a vehicle computer model, wherein said controller is programmed to

determine a rear side slip angle of said vehicle computer model;

determine an initial steering wheel angle that is input to said vehicle computer model;

when said rear side slip angle is determined to be greater than a predetermined threshold, determine a look ahead scale factor and increase the distance of a look ahead point substantially on or near an intended vehicle path as a function of said look ahead scale factor;

determine a new steering wheel angle, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path;

operate said vehicle computer model with said initial steering wheel angle or said new steering wheel angle; and

generate an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle.

2. (Previously presented) A simulation system as recited in claim 1, wherein said predetermined threshold is about 15 degrees.

3. (Previously presented) A simulation system as recited in claim 1, wherein said controller is programmed to determine both a longitudinal vehicle velocity and a lateral vehicle velocity and also

determine said rear side slip angle as a function of said longitudinal vehicle velocity and said lateral vehicle velocity.

4. (Previously presented) A simulation system as recited in claim 1, wherein said controller is programmed to determine said look ahead scale factor as a function of said rear side slip angle.

5. (Previously presented) A simulation system as recited in claim 1, wherein said controller is programmed to determine said look ahead scale factor as a function of an exponential of said rear side slip angle.

6. (Previously presented) A simulation system as recited in claim 1, wherein said controller is programmed to determine said look ahead scale factor as a function of an exponential of a product of said rear side slip angle and a constant.

7. (Previously presented) A simulation system as recited in claim 6, wherein said constant is about 0.02.

8. (Previously presented) A simulation system as recited in claim 1, wherein said rear side slip angle is determined to not be greater than said predetermined threshold, said controller is alternatively programmed to determine an unscaled look ahead factor.

9. (Previously presented) A simulation system as recited in claim 1, wherein said controller is programmed to determine said new steering wheel angle when said vehicle computer model is determined to not be headed on target, and said target is associated with said intended vehicle path.

10. (Previously presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method being operable on a digital computer system and comprising the steps of:

(a) determining a rear side slip angle of said vehicle computer model;

(b) determining an initial steering wheel angle that is input to said vehicle computer model;

(c) when said rear side slip angle is determined to be greater than a predetermined threshold, determining a look ahead scale factor and increasing the distance of a look ahead point substantially on or near an intended vehicle path as a function of said look ahead scale factor;

(d) determining a new steering wheel angle, which is input to said vehicle computer model at a time later than said initial steering wheel angle, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path;

(e) operating said vehicle computer model with said initial steering wheel angle or said new steering wheel angle; and

(f) generating an output in response to said vehicle computer model and said initial steering wheel angle or said new steering wheel angle.

11. (Previously presented) A method as recited in claim 10, wherein said predetermined threshold is about 15 degrees.

12. (Previously presented) A method as recited in claim 10, wherein step (a) is at least partially accomplished by determining both a longitudinal vehicle velocity and a lateral vehicle velocity and also determining said rear side slip angle as a function of said longitudinal vehicle velocity and said lateral vehicle velocity.

13. (Previously presented) A method as recited in claim 10, wherein said look ahead scale factor is determined as a function of said rear side slip angle.

14. (Previously presented) A method as recited in claim 10, wherein said look ahead scale factor is determined as a function of an exponential of said rear side slip angle.

15. (Previously presented) A method as recited in claim 10, wherein said look ahead scale factor is determined as a function of an exponential of a product of said rear side slip angle and a constant.

16. (Previously presented) A method as recited in claim 15, wherein said constant is about 0.02.

17. (Previously presented) A method as recited in claim 10, said method further comprising the step of when said rear side slip angle is determined to not be greater than said predetermined threshold, alternatively determining an unscaled look ahead factor.

18. (Previously presented) A method as recited in claim 10, said method further comprising the step of determining said new steering wheel angle when said vehicle computer model is determined to not be headed on target, said target being associated with said intended vehicle path.

19. (Previously presented) A method of operating a vehicle computer model having vehicle information and path information therein, said method comprising the steps of:

determining a rear side slip angle of said vehicle computer model;

determining an initial steering wheel angle that is input to said vehicle computer model;

determining a look ahead point that is substantially on or near an intended vehicle path for said vehicle computer model;

when said rear side slip angle is determined to be greater than a predetermined threshold, determining a look ahead scale factor and increasing the distance of said look ahead point as a function of said look ahead scale factor;

when said rear side slip angle is alternatively determined to be less than said predetermined threshold, maintaining the distance of said look ahead point;

when said vehicle computer model is determined to be headed off a predetermined target, determining a new steering wheel angle, which is input to said vehicle computer model, by comparing said intended vehicle path with said look ahead point on or near said intended vehicle path;

operating said vehicle computer model with said initial steering wheel angle or said new steering wheel angle; and

generating an output in response to said vehicle computer model and said initial steering wheel angel or said new steering wheel angle.

20. (Previously presented) A method as recited in claim 19, wherein said look ahead scale factor is determined as a function of an exponential of said rear side slip angle.

IX. Evidence Appendix

There is no Evidence Appendix herein.

X. Related Proceedings Appendix

10/707,368 an Appeal Brief was filed 7/23/07 and the board has yet to render its decision.

10/707,366 an Appeal Brief was filed 6/22/09 and the board has yet to render its decision.